Lab: Heat of Solution

Purpose:
To calculate the heat of solution for two salts.

Background:
For a given solute, the heat of solution is the change in energy that occurs as one mole of the solute dissolves in water. During the dissolving process, solutes either absorb or release energy. If solutes absorb energy from the water as they dissolve, the water gets colder and the reaction is endothermic. If solutes release energy to the water as they dissolve, the water gets warmer and the reaction is exothermic.

By using a calorimeter and measuring the change in the temperature of the water during the dissolving process, you can calculate the heat of solution. In calorimetry, an assumption is made that the change in heat of the substance (ΔH_{solute}) is equal to the change in heat of the water (ΔH_{water}). The change in heat of the water is calculated using the formula:

$$\Delta H_{water} = \text{mass}_{water} \times \Delta T_{water} \times \text{specific heat}_{water}$$

Where: ΔH_{water} = change in heat of the water
mass_{water} = mass of the sample of water
ΔT = change in temperature of the water
$\text{specific heat}_{water}$ = 4.184 J/g ·°C

Materials

- Calorimeter
- electronic balance
- thermometer
- 100 mL graduated cylinder
- Variety of salts available:

Procedure:

1. Accurately find the mass of about 100 mL of tap water. Record this value and other measurements in the data table. Add the water to the calorimeter.
2. Accurately find the mass of about 15 g of one of the salts provided.
3. Find and record the initial temperature of the water. Record to the nearest 0.2°C.
4. Dissolve the solid in the water, stirring constantly to make sure it dissolves completely.
5. Record the maximum temperature difference from the initial reading.
6. Rinse out the cup, dry it thoroughly, and repeat the experiment using a sample of about 15 g of another salt available.

Observations:

Table 1: _____

Substance	Mass of Water used (g±0.02g)	Mass of solute (g±0.02g)	Initial temperature of water (˚C±0.1˚C)	Final temperature of water (˚C±0.1˚C)

Calculations:

1. For each of the solutes, calculate the change in temperature (ΔT) of the water.

2. Calculate the mass of the 100 ml of water in the calorimeter. The density of water at 25˚C is 1.0 g/mL.

3. Calculate the change in heat of the water with each solute.

$$(\Delta H_{water} = \text{mass}_{water} \times \Delta T_{water} \times \text{specific heat}_{water})$$

4. Calculate the number of moles of each solute.

5. Calculate the molar heat of solution for each solute. $(\Delta H_{solute}/moles_{solute})$
   Remember: Δ*H* is positive for endothermic changes and negative for exothermic changes.

6. Search the acceptable values for the enthalpy of solution of your chosen salts and calculate the percent of error for each solute.

7. Compare the results with classmates and classify all the salts provided for this lab as forming endothermic solution or exothermic solutions.